Raman variation of organic matter in large cluster IDPs and meteoritic IOM

Conference or Workshop Item

RAMAN VARIATION OF ORGANIC MATTER IN LARGE CLUSTER IDPs AND METEORITIC IOM.

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Introduction: CP-IDPs display a range of primitive features indicative of a cometary origin. The organic material (OM) present in IDPs may be the result of formation processes that occurred across a large volume of the protoplanetary disk to small-scale on the cometary body itself. Raman microscopy offers a non-destructive approach for determining general characteristics of the OM in IDPs. Compared to the large number of potential parent bodies or the huge volume of the protoplanetary disk that may have contributed to the formation of comets, the number of IDPs analysed to date remains relatively small. Raman measurements were performed on 9 IDPs (from 5 large cluster particles; collectors L2005 and L2006) offering the opportunity to investigate the variability of the OM on a number of scales. Previous Raman analyses of IDPs and IOM from meteorites have used a number of different wavelengths, predominantly green. While it has been shown that D band position (ωD) is influenced by excitation λ [1], it is rarely quantified. Interestingly, the wavelength dependent shift in the ωG is known to vary with degree of ordering of OM. Multi-wavelength analyses made here offer an independent measure of organic maturity.

Results: Meteoritic IOM (samples as in [2]) and IDPs mapped using 514nm and 473nm lasers showed a reproducible downshift of 10-13 cm^{-1} in ωD. For ωG, the IDPs displayed a larger downshift (~4 cm^{-1}) than the IOM (negligible). The range of ωD and ωG in any one IDP cluster is limited, with values comparable to meteoritic IOM. For particles within individual clusters, ωD varies by <6 cm^{-1} and ωG by <3 cm^{-1}. Each cluster IDP displays distinctive internal peak parameter co-variation.

Discussion: The large ΓD and ΓG, high ωD, low ωG and ID/IG ratios of 0.9-1.3 indicate that the IDPs are all primitive. The samples plot near to the CI, CM and CR field. The dispersion in ωG with excitation λ is related to the degree of disordering of the carbon [1], and therefore the greater ωG dispersion observed for the IDPs suggests that the OM in the IDPs may be more disordered than meteoritic IOM, in contrast to their similar peak parameters. The IDPs selected for this study do not appear to be as primitive as Grigg-Skjellerup Collection (GSC) particles [3], but are comparable to other non-GSC IDPs [4].

While great isotopic and structural variability exists within individual particles at the sub-µm scale (e.g. [3]), these results indicate that the OM within IDPs is reasonably homogeneous at the few to tens of µm-scale, and that there is greater variability between particles than within. The variability between particles most likely reflects accretion from different reservoirs, potentially on the scale of individual comets given the distinctive signatures from GSC-IDPs [3]. Secondary processes on the comet, in interplanetary space or during atmospheric entry may also play a role despite low peak metamorphic temperatures (<200^{o}C (after [5])).

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